The Examiner rejects claims 1-14 under 35 U.S.C. §112, second paragraph, as being indefinite. The Examiner states that claim 1 is unclear whether the vertical rib has to be on the same side of the sheet as the studs. By the foregoing amendment, claim 1 has been amended to recite a first side of the sheet in order to clarify the claim.

With respect to claim 4, the "and/or" language has been deleted and substituted by conventional Markush language.

With respect to claim 8, the claim has now been amended to recite that the ribs are formed of a different material than the separator sheet.

Claim 9 has been amended to provide a positive recitation of the electrode plate.

Claim 5 has been amended by deleting the term "continuous".

The Examiner rejects claims 1-5 and 7 under 35 U.S.C. §102(b) as being anticipated by Grimes et al, U.S. Patent No. 4,396,689. The Examiner states that Grimes teaches an electrochemical cell with a novel separator-spacer that has a microporous mid-portion surface which is recessed from a non-porous surface of the sides, and that projections on the microporous surface are designed to maintain a spaced compartmental distance between the separator and the flat conductive surfaces of the electrode sheets.

The present invention pertains to separators for sulphuric acid storage batteries. These separators have the form of pockets which contain the positive or negative electrodes. The separators are provided with a plurality of studs and at least one elongated vertical rib. It was found by the present inventors that a combination of a plurality of studs and at least one vertical rib is sufficient to prevent a direct contact of the separator sheet with the electrode plates, and in particular, with the edges of the electrode plates without showing the disadvantages of separators provided with a plurality of ribs, such as increased electric resistance and acid displacement, reduced discharge capacity,

increased production costs and problems during pocketing of the electrode plates (compare the discussion of the prior art at pages 1-2 of the specification).

The separators of the present invention are not anticipated or rendered obvious by the prior art. Specifically, Grimes et al. disclose zinc-bromine batteries. The zinc-bromine system is a two-phase system which comprises two electrolytes which are circulated through separate compartments of the cell by pumps 12 and 14 (column 4, lines 6-26 and Figure 1). These compartments are separated by a separator 18 (column 4, lines 27-29) which prevents or hinders movement of anions such as the bromide and tribromide ions from the cathode compartment to the anode compartment (column 4, lines 27-35). Zinc-bromide batteries comprise an aqueous and a non-aqueous electrolyte (column 4, lines 19-26). The separators used in the zinc-bromide system comprise a microporous sheet which is surrounded by a non-porous border (column 2, lines 43-58; Figs. 3 and 6). The separator may be provided with a number of projections 32 the design of which allows for an expeditious flow of electrolyte through the two compartments without entrapping gas bubbles (column 5, lines 26-30). Grimes et al. do not disclose pocket type separators. Grimes et al. also do not disclose separators provided in the form of a roll.

The separators disclosed by Grimes et al. are specifically adapted to the zinc-bromide batteries which differ considerably from lead acid batteries. While the separators of Grimes et al. are provided with a non-porous border, it is the intention of the present invention to reduce the electrical resistance of the separator, i.e., to have non-porous portions and portions with increased resistance such as ribs as little as possible. It is an important object of the present invention to ensure good ionic conduction, whereas the separators of Grimes et al. prevent or hinder movement of anions such as bromide and tribromide ions between the two compartments of the battery. The separators of the present invention are adapted to lead acid batteries which contain an aqueous electrolyte only, i.e., sulphuric acid,

whereas zinc-bromide batteries contain an aqueous and a non-aqueous electrolyte (column 4, lines 6-26). In zinc-bromine systems, rod-shaped projections may be used in order to allow for an expeditious flow of the electrolyte (column 5, lines 21-30), and thus serve a different purpose that the ribs of the pocket separators of the present invention. As can be seen from Figure 1 of Grimes et al., these projections do not prevent a direct contact of the separator sheet with the electrode plates, but only guide the electrolyte flow through the system. In addition, the circulation of the electrolyte in the zinc-bromine system excludes the use of pocket type separators (c.f. Figure 1 of Grimes et al.).

It follows that the requirements of a lead acid and zinc-bromine battery are totally different and therefore a skilled artisan interested in producing pocket type separators for lead acid batteries with reduced electrical resistance, reduced acid displacement and with the object of avoiding misalignments during pocketing of the electrode would not have regarded the disclosure of Grimes et al. to be relevant, and, therefore, the present invention as now claimed is believed to be patentable over Grimes et al. In addition, the zinc-bromide system of Grimes et al. requires sheet separators which have a certain rigidity and which therefore cannot be rolled up, but are only used in the form of sheets.

The Examiner rejects claims 1, 3, 4, 7, 10-12 and 14 under 35 U.S.C. §102(b) as being anticipated by Holmes, U.S. Patent No. 1,116,818.

Holmes discloses storage batteries comprising positive lead electrodes and negative zinc/mercury electrodes (page 1, lines 64-75). The electrodes are placed within a rubber receptacle which is divided into three different compartments by two partition walls (page 1, lines 29-53). The partition walls are provided on each side with knobs which have the purpose of preventing a direct contact of the electrodes with the faces of the walls (page 1, lines 53-58). The walls are perforated in order to allow the sulphuric acid electrolyte to circulate throughout the battery (page 1, lines 82-

90). The middle compartment of the receptacle is provided at the bottom with two transversely extending ribs for the purpose of supporting the electrode plate (page 1, lines 40-47).

Holmes does not disclose separators according to the present invention comprising a microporous sheet and also does not disclose or suggest pocket separators as now claimed. Moreover, according to Holmes, the receptacle and not the partition walls are provided with ribs. Accordingly, it is believed that the claims are patentable over Holmes.

The Examiner rejects claims 6, 13 and 14 under 35 U.S.C. §103(a) as being unpatentable over Grimes et al.; claims 8-9 as being unpatentable over Grimes et al. in view of Battersby; and claims 10-12 and 14 as being unpatentable over Grimes et al. in view of Willmann et al.

These claims are believed to be allowable for the reasons stated above regarding Grimes et al. In addition, Battersby discloses battery separators provided with a plurality of polymeric ribs on at least one separator surface. These separators of Battersby are typical examples for the separators according to the prior art, as discussed in the background section of the present application. Battersby does not describe separators which, in addition to the ribs, are provided with a plurality of studs. Moreover, Battersby does not disclose pocket type separators. Accordingly, Battersby does not supply the deficiencies of Grimes et al. noted above.

Willmann discloses electrolyte-immobilizing mats for lead acid storage batteries. The separators may be provided with a number of protuberances or ribs. Separators which are provided with a combination of protuberances and ribs are not mentioned. According to column 10, lines 4-6, the separator may be wrapped around, or enveloped about, the bottom edge of the negative electrodes. Willmann, therefore , also does not disclose pocket separators according to the present invention. Pocket separators are formed by folding the separator in the middle, inserting an electrode plate in the folded separators and then sealing the side edges of the separator (compare the paragraph bridging

pages 8 and 9 of the instant specification). Accordingly, Willmann does not supply the deficiencies of Grimes et al. noted above.

Reconsideration and allowance are respectfully requested in view of the foregoing amendment and remarks.

Respectfully submitted,

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Version With Markings to Show Changes

1. (Amended) A pocket battery separator for a lead-acid storage battery, said separator comprising a [porous] microporous sheet having a center area and side areas and being provided with a plurality of studs on at least [one] a first side of the sheet, characterized in that the separator additionally comprises at least one elongated vertical rib in the center area of at least [one] said first side of the sheet provided with a plurality of studs.

2. (unchanged)

3. (unchanged)

4. (Amended) The separator as defined in claim 1 wherein the studs have [the] a form selected from the group consisting of truncated cones, truncated pyramids, [and/or] spherical caps and combinations thereof.

5. (Amended) The separator as defined in claim 1 wherein [the continuous ribs have] said at least one elongated vertical rib has the same or a lower height than the studs.

6. (unchanged)

7. (unchanged)

8. (Amended) The separator as defined in claim 1 wherein the [studs and/or the] ribs ~~are~~ at least one formed of a different material than the separator sheet.

9. (Amended) A pocket battery separator for a lead-acid storage battery containing an electrode plate, said separator [The separator as defined in claim 1] comprising a porous sheet having a center area and side areas and being provided with a plurality of studs on at least one side of the sheet, said separator further comprising [and] at least one separate rib which is applied to the electrode plate and located in the center area of the sheet.

10. (canceled)

11. (Amended) The separator of claim [10] 1 in which the studs and at least one vertical ribs are provided on the inner [surfaces] surface of the pocket.

12. (Amended) The separator of claim [10] 1 wherein the at least one elongated rib is arranged in the bottom edge area of the separator pocket.

13. (Amended) [The separator of claim 1] A rolled-up battery separator for a lead acid storage battery, said separator comprising a porous sheet having a center area and side areas and being provided with a plurality of studs on at least a first side of the sheet, characterized in that the separator additionally comprises at least one elongated vertical rib in the center area of at least said first side of the sheet provided with a plurality of studs, said separator being adapted to be cut into pieces for insertion in said lead-acid storage battery [provided in form of a roll].

14. (unchanged)

Replacement Sheets

B1

1. (Amended) A pocket battery separator for a lead-acid storage battery, said separator comprising a microporous sheet having a center area and side areas and being provided with a plurality of studs on at least a first side of the sheet, characterized in that the separator additionally comprises at least one elongated vertical rib in the center area of at least said first side of the sheet provided with a plurality of studs.

2. (unchanged) The separator as defined in claim 1 wherein the elongated rib is a continuous rib.

3. (unchanged) The separator as defined in claim 1 comprising 2 to 4 elongated vertical ribs in the center area of the separator sheet.

B2

4. (Amended) The separator as defined in claim 1 wherein the studs have a form selected from the group consisting of truncated cones, truncated pyramids, spherical caps and combinations thereof.

5. (Amended) The separator as defined in claim 1 wherein said at least one elongated vertical rib has the same or a lower height than the studs.

6. (unchanged) The separator as defined in claim 1 wherein the continuous ribs have the same or a lower height than the studs.

7. (unchanged) The separator as defined in claim 1 wherein the studs and the ribs are solid bodies integrally formed of the same material as the separator sheet.

B3

8. (Amended) The separator as defined in claim 1 wherein the ribs are formed of a different material than the separator sheet.

9. (Amended) The separator as defined in claim 1 containing an electrode plate and comprising a porous sheet being provided with a plurality of studs on at least one side of the sheet

and at least one separate rib applied to the electrode plate.

10. (canceled)

11. (Amended) The separator of claim 1 in which the studs and vertical ribs are provided on the inner surface of the pocket.

12. (Amended) The separator of claim 1 wherein the at least one elongated rib is arranged in the bottom edge area of the separator pocket.

B4

13. (Amended) A rolled-up battery separator for a lead-acid storage battery, said separator comprising a porous sheet having a center area and side areas and being provided with a plurality of studs on at least a first side of the sheet, characterized in that the separator additionally comprises at least one elongated vertical rib in the center area of at least said first side of the sheet provided with a plurality of studs, said separator being adapted to be cut into pieces for insertion in said lead-acid storage battery.

14. (unchanged) A lead acid storage battery comprising at least one separator according to claim 1.